

SEQUENCE LISTING

<110> Shinoda, Tetsuro
Itoyama, Kyo
Hamamura, Tetsuzo

<120> JUVENILE HORMONE ACID METHYLTRANSFERASE
GENES AND METHODS OF USING SAME

<130> 480230.401USPC

<140> US 10/542,867
<141> 2003-01-20

<150> PCT/JP03/00415
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<170> PatentIn version 3.1

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Arg Asp Ala Leu Arg Cys Leu Glu Glu His Ala Asn Lys Ile Lys Trp
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gtt act gat att ttg aaa gtt tac atg cca aaa aat tac gga aga tta 313
Val Thr Asp Ile Leu Lys Val Tyr Met Pro Lys Asn Tyr Gly Arg Leu
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|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Lys | Ile | Gly | Asp | Arg | Val | Ile | Asp | Leu | Gly | Cys | Ala | Asp | Gly | Ser | Val |
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Gly Cys Asp Ile Ser Glu Glu Met Val Lys Tyr Ala Asn Lys His His
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Gly Phe Gly Arg Thr Ser Phe Arg Val Leu Asp Ile Glu Gly Asp Leu
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Thr Ala Asp Leu Lys Gln Gly Phe Asp His Val Phe Ser Phe Tyr Thr
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Leu His Trp Ile Arg Asp Gln Glu Arg Ala Phe Arg Asn Ile Phe Asn
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Leu Leu Gly Asp Glu Gly Asp Cys Leu Leu Leu Phe Leu Gly His Thr
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Pro Ile Phe Asp Val Tyr Arg Thr Leu Ser His Thr Glu Lys Trp His
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Ser Trp Leu Glu His Val Asp Arg Phe Ile Ser Pro Tyr His Asp Asn
165 170 175

Glu Asp Pro Glu Lys Glu Val Lys Lys Ile Met Glu Arg Val Gly Phe
180 185 190

Ser Asn Ile Glu Val Gln Cys Lys Thr Leu Phe Tyr Val Tyr Asp Asp
 195 200 205
 Leu Asp Val Leu Lys Lys Ser Val Ala Ala Ile Asn Pro Phe Asn Ile
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 Pro Lys Asp Ile Leu Glu Asp Phe Leu Glu Asp Tyr Ile Asp Val Val
 225 230 235 240
 Arg Glu Met Arg Leu Leu Asp Arg Cys Asn Asn Asn Val Gly Glu Ser
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| Asp Ala Lys Leu Ile Leu Asp Glu Phe Ala Ser Thr Met Gln Trp Arg | | |
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| tcc gat gga gag gat gcc ctc ctg gat gtg ggt tca gga tct ggt aac | | 144 |
| Ser Asp Gly Glu Asp Ala Leu Leu Asp Val Gly Ser Gly Ser Gly Asn | | |
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| Val Leu Met Asp Phe Val Lys Pro Leu Leu Pro Ile Arg Gly Gln Leu | | |
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| 65 70 75 80 | | |
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| Tyr Gln Arg Glu Glu Arg Thr Arg Phe Gln Val Leu Asp Ile Gly Cys | | |
| 85 90 95 | | |

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| ttc tac tgc ctc cat tgg gtg caa aat ctg aaa gga gct ctc gga aat Phe Tyr Cys Leu His Trp Val Gln Asn Leu Lys Gly Ala Leu Gly Asn 115 120 125 | 384 |
| atc tac aat ctt ctg aag ccc gaa ggt ggc gac tgc ctc ctg gca ttt Ile Tyr Asn Leu Leu Lys Pro Glu Gly Gly Asp Cys Leu Leu Ala Phe 130 135 140 | 432 |
| ttg gcc tcc aat ccg gtt tac gaa gtc tat aag att ctt aaa acg aat Leu Ala Ser Asn Pro Val Tyr Glu Val Tyr Lys Ile Leu Lys Thr Asn 145 150 155 160 | 480 |
| gac aag tgg tcg act tat atg cag gat gtg gag aac ttc ata tcc cca Asp Lys Trp Ser Thr Tyr Met Gln Asp Val Glu Asn Phe Ile Ser Pro 165 170 175 | 528 |
| ctt cac tac agt cta aat cct ggc gag gaa ttc agc cag ttg ttg aac Leu His Tyr Ser Leu Asn Pro Gly Glu Phe Ser Gln Leu Leu Asn 180 185 190 | 576 |
| gat gtg ggt ttc gtg caa cac aat gtg gaa att cga aac gaa gtg ttt Asp Val Gly Phe Val Gln His Asn Val Glu Ile Arg Asn Glu Val Phe 195 200 205 | 624 |
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| cct ttt ctt gag cga atg cct gca gat ttg cat gaa cag ttc ctg gat Pro Phe Leu Glu Arg Met Pro Ala Asp Leu His Glu Gln Phe Leu Asp 225 230 235 240 | 720 |
| gac ttc ata gac att gtt ata tcc atg aat ttg cag caa ggt gaa aat Asp Phe Ile Asp Ile Val Ile Ser Met Asn Leu Gln Gln Gly Glu Asn 245 250 255 | 768 |
| aat gag gat caa aag ttc cta tct ccc tat aaa ctg gtg gtg gcc tat Asn Glu Asp Gln Lys Phe Leu Ser Pro Tyr Lys Leu Val Val Ala Tyr 260 265 270 | 816 |
| gct cgc aag act cct gaa ttt gtg aat aat gtt ttc ctg gag cct aca Ala Arg Lys Thr Pro Glu Phe Val Asn Asn Val Phe Leu Glu Pro Thr 275 280 285 | 864 |
| cat caa aac ttg gtt aag gga ata aat taa ttttatttta caaattaaca His Gln Asn Leu Val Lys Gly Ile Asn 290 295 | 914 |
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| 1 | | | | 5 | | | | | 10 | | | | | 15 | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Asp | Ala | Lys | Leu | Ile | Leu | Asp | Glu | Phe | Ala | Ser | Thr | Met | Gln | Trp | Arg |
| | | | | 20 | | | 25 | | | | | 30 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ser | Asp | Gly | Glu | Asp | Ala | Leu | Leu | Asp | Val | Gly | Ser | Gly | Ser | Gly | Asn |
| | | | | | 35 | | 40 | | | | 45 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Val | Leu | Met | Asp | Phe | Val | Lys | Pro | Leu | Leu | Pro | Ile | Arg | Gly | Gln | Leu |
| | | | | | 50 | | 55 | | | 60 | | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Val | Gly | Thr | Asp | Ile | Ser | Ser | Gln | Met | Val | His | Tyr | Ala | Ser | Lys | His |
| 65 | | | | | 70 | | | 75 | | | 80 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Tyr | Gln | Arg | Glu | Glu | Arg | Thr | Arg | Phe | Gln | Val | Leu | Asp | Ile | Gly | Cys |
| | | | | | 85 | | | 90 | | | | 95 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Glu | Arg | Leu | Pro | Glu | Glu | Leu | Ser | Gly | Arg | Phe | Asp | His | Val | Thr | Ser |
| | | | | | 100 | | 105 | | | | 110 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Phe | Tyr | Cys | Leu | His | Trp | Val | Gln | Asn | Leu | Lys | Gly | Ala | Leu | Gly | Asn |
| | | | | | 115 | | 120 | | | 125 | | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Ile | Tyr | Asn | Leu | Leu | Lys | Pro | Glu | Gly | Gly | Asp | Cys | Leu | Leu | Ala | Phe |
| | | | | | 130 | | 135 | | | 140 | | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Leu | Ala | Ser | Asn | Pro | Val | Tyr | Glu | Val | Tyr | Lys | Ile | Leu | Lys | Thr | Asn |
| 145 | | | | | 150 | | | 155 | | | 160 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Asp | Lys | Trp | Ser | Thr | Tyr | Met | Gln | Asp | Val | Glu | Asn | Phe | Ile | Ser | Pro |
| | | | | | 165 | | | 170 | | | 175 | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Leu | His | Tyr | Ser | Leu | Asn | Pro | Gly | Glu | Glu | Phe | Ser | Gln | Leu | Leu | Asn |
| | | | | | 180 | | 185 | | | 190 | | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Asp | Val | Gly | Phe | Val | Gln | His | Asn | Val | Glu | Ile | Arg | Asn | Glu | Val | Phe |
| | | | | | 195 | | 200 | | | 205 | | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Val | Tyr | Glu | Gly | Val | Arg | Thr | Leu | Lys | Asp | Asn | Val | Lys | Ala | Ile | Cys |
| | | | | | 210 | | 215 | | | 220 | | | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Pro | Phe | Leu | Glu | Arg | Met | Pro | Ala | Asp | Leu | His | Glu | Gln | Phe | Leu | Asp |
| 225 | | | | | | 230 | | | 235 | | | 240 | | | |

| | | | | | | | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Asp | Phe | Ile | Asp | Ile | Val | Ile | Ser | Met | Asn | Leu | Gln | Gln | Gly | Glu | Asn |
| | | | | | 245 | | 250 | | | 255 | | | | | |

Asn Glu Asp Gln Lys Phe Leu Ser Pro Tyr Lys Leu Val Val Ala Tyr
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 Gln Phe Ser His Val Thr Ser Phe Tyr Cys Leu His Trp Val Gln Asn
 115 120 125

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| Gln His Val Ala Phe Ser Asn Ile Tyr Asn Leu Leu Gln His Gly Gly | | | |
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| gac tgt ctg ctg gtg ttt ttg gca aac aac cca atc ttt gac ata tac | | 480 | |
| Asp Cys Leu Leu Val Phe Leu Ala Asn Asn Pro Ile Phe Asp Ile Tyr | | | |
| 145 | 150 | 155 | 160 |
| aac caa ctg tct cgc tca ccc aag tgg tcc aag tat atg tac gac gtg | | 528 | |
| Asn Gln Leu Ser Arg Ser Pro Lys Trp Ser Lys Tyr Met Tyr Asp Val | | | |
| 165 | 170 | 175 | |
| gaa aag tac att tcg ccc tac cag tat tgt gaa aat cca gca agt gag | | 576 | |
| Glu Lys Tyr Ile Ser Pro Tyr Gln Tyr Cys Glu Asn Pro Ala Ser Glu | | | |
| 180 | 185 | 190 | |
| atc gag gat ctg ctg tgc acg gtg ggc ttt cag cag tat cag ata cag | | 624 | |
| Ile Glu Asp Leu Leu Cys Thr Val Gly Phe Gln Gln Tyr Gln Ile Gln | | | |
| 195 | 200 | 205 | |
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| Val Arg Asp Lys Leu Tyr Val Tyr Glu Gly Leu Asp Asn Leu Lys Arg | | | |
| 210 | 215 | 220 | |
| gca gtt ttg gct gtg aat cca ttc agt gaa cga atg cca cca gaa ctg | | 720 | |
| Ala Val Leu Ala Val Asn Pro Phe Ser Glu Arg Met Pro Pro Glu Leu | | | |
| 225 | 230 | 235 | 240 |
| cag gat agg ttc cta ctg gac tat atc gct gtt gtg cgg cag atg tac | | 768 | |
| Gln Asp Arg Phe Leu Leu Asp Tyr Ile Ala Val Val Arg Gln Met Tyr | | | |
| 245 | 250 | 255 | |
| ttg acc aaa act ggc agc gaa gag aat gat tgc aat ctt caa ttc ata | | 816 | |
| Leu Thr Lys Thr Gly Ser Glu Glu Asn Asp Cys Asn Leu Gln Phe Ile | | | |
| 260 | 265 | 270 | |
| tcc cca tac aag ttg gtg gtt gtt tat gcg aag aaa taa | | 855 | |
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| His Ala Arg Glu Ser Tyr Arg His Val Lys Thr Ile Glu Phe Asp Thr | | | |
| 85 | 90 | 95 | |
| Leu Asp Ile Gly Ile Lys Leu Asp Ser Ala Lys Leu Ser Arg Trp Gly | | | |
| 100 | 105 | 110 | |
| Gln Phe Ser His Val Thr Ser Phe Tyr Cys Leu His Trp Val Gln Asn | | | |
| 115 | 120 | 125 | |
| Gln His Val Ala Phe Ser Asn Ile Tyr Asn Leu Leu Gln His Gly Gly | | | |
| 130 | 135 | 140 | |
| Asp Cys Leu Leu Val Phe Leu Ala Asn Asn Pro Ile Phe Asp Ile Tyr | | | |
| 145 | 150 | 155 | 160 |
| Asn Gln Leu Ser Arg Ser Pro Lys Trp Ser Lys Tyr Met Tyr Asp Val | | | |
| 165 | 170 | 175 | |
| Glu Lys Tyr Ile Ser Pro Tyr Gln Tyr Cys Glu Asn Pro Ala Ser Glu | | | |
| 180 | 185 | 190 | |
| Ile Glu Asp Leu Leu Cys Thr Val Gly Phe Gln Gln Tyr Gln Ile Gln | | | |
| 195 | 200 | 205 | |
| Val Arg Asp Lys Leu Tyr Val Tyr Glu Gly Leu Asp Asn Leu Lys Arg | | | |
| 210 | 215 | 220 | |
| Ala Val Leu Ala Val Asn Pro Phe Ser Glu Arg Met Pro Pro Glu Leu | | | |
| 225 | 230 | 235 | 240 |
| Gln Asp Arg Phe Leu Leu Asp Tyr Ile Ala Val Val Arg Gln Met Tyr | | | |
| 245 | 250 | 255 | |
| Leu Thr Lys Thr Gly Ser Glu Glu Asn Asp Cys Asn Leu Gln Phe Ile | | | |
| 260 | 265 | 270 | |
| Ser Pro Tyr Lys Leu Val Val Tyr Ala Lys Lys | | | |
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 Leu Asn Phe Leu Asp Asp Ile Ser Pro Lys Leu Lys Trp Lys Lys Ser
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 Ile Ser Asn Ile Leu Asp Val Gly Cys Gly Asp Gly Cys Val Thr Ser
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 Met Leu Lys Lys Tyr Ile Pro Thr Asp Phe Lys Leu Leu Gly Cys Asp
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atc agt gag aag atg gtg aat ttc gcc aat gac cac cat tgc aat gaa 356
 Ile Ser Glu Lys Met Val Asn Phe Ala Asn Asp His His Cys Asn Glu
 70 75 80

cag acg tcg ttc aca gtg ctg gac atc gca gga gat ata ccc gaa ggt 404
 Gln Thr Ser Phe Thr Val Leu Asp Ile Ala Gly Asp Ile Pro Glu Gly
 85 90 95

atg aag gga aaa ttc gac cat gtt ttc tcc ttc tat gcc ttg cac tgg 452
 Met Lys Gly Lys Phe Asp His Val Phe Ser Phe Tyr Ala Leu His Trp
 100 105 110

gtc ttg gat caa gag cgc gta ttc agg aat att tac gat ttg ctg agt 500
 Val Leu Asp Gln Glu Arg Val Phe Arg Asn Ile Tyr Asp Leu Leu Ser
 115 120 125 130

aaa gat gga gaa tgc ttc acg ata ttt gtc gca ggc gca ccc gtg ttc 548
 Lys Asp Gly Glu Cys Phe Thr Ile Phe Val Ala Gly Ala Pro Val Phe
 135 140 145

gac ttg tac cgc att tta tcg cgt aac aac aaa tgg agc act ctg ctt 596
 Asp Leu Tyr Arg Ile Leu Ser Arg Asn Asn Lys Trp Ser Thr Leu Leu
 150 155 160

aaa gat gtc gag aaa tac ata tcg cca tac cac gac tca cag gat cca 644
 Lys Asp Val Glu Lys Tyr Ile Ser Pro Tyr His Asp Ser Gln Asp Pro
 165 170 175

| | |
|--|-----|
| gcg aaa gaa atg aga aaa gta ttg gaa aaa gtt gga tac gtg gac tac | 692 |
| Ala Lys Glu Met Arg Lys Val Leu Glu Lys Val Gly Tyr Val Asp Tyr | |
| 180 185 190 | |
| aag gtg gaa tgt aaa aac ttg gtg tat atg tac aac aac ttc gcc agt | 740 |
| Lys Val Glu Cys Lys Asn Leu Val Tyr Met Tyr Asn Asn Phe Ala Ser | |
| 195 200 205 210 | |
| tta tgg aaa acc ctt caa gca atc aac cca ttc aac atc ccg aaa gat | 788 |
| Leu Trp Lys Thr Leu Gln Ala Ile Asn Pro Phe Asn Ile Pro Lys Asp | |
| 215 220 225 | |
| atg gaa gaa gat ttc aaa caa gat tac tta aat att tta aaa gat atg | 836 |
| Met Glu Glu Asp Phe Lys Gln Asp Tyr Leu Asn Ile Leu Lys Asp Met | |
| 230 235 240 | |
| aaa att gtg tct aag tat aat acc gat gag gca agt gtg aac ttc aaa | 884 |
| Lys Ile Val Ser Lys Tyr Asn Thr Asp Glu Ala Ser Val Asn Phe Lys | |
| 245 250 255 | |
| tat cgg ttg ctt gtc gta cac gct cgc aag ccg gcc tca gaa ttt tag | 932 |
| Tyr Arg Leu Leu Val Val His Ala Arg Lys Pro Ala Ser Glu Phe | |
| 260 265 270 | |
| ggaaaataat cacaataaaa ctaactgaat atttgttagta caataacaaa acctgatgca | 992 |
| ag | 994 |
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| <211> 273 | |
| <212> PRT | |
| <213> Spodoptera litura | |
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| Met Asn Asn Ala Val Leu Tyr Glu Gln Ala Asn Ser Met Gln Lys Arg | |
| 1 5 10 15 | |
| Asp Ala Leu Asn Phe Leu Asp Asp Ile Ser Pro Lys Leu Lys Trp Lys | |
| 20 25 30 | |
| Lys Ser Ile Ser Asn Ile Leu Asp Val Gly Cys Gly Asp Gly Cys Val | |
| 35 40 45 | |
| Thr Ser Met Leu Lys Lys Tyr Ile Pro Thr Asp Phe Lys Leu Leu Gly | |
| 50 55 60 | |
| Cys Asp Ile Ser Glu Lys Met Val Asn Phe Ala Asn Asp His His Cys | |
| 65 70 75 80 | |
| Asn Glu Gln Thr Ser Phe Thr Val Leu Asp Ile Ala Gly Asp Ile Pro | |
| 85 90 95 | |

Glu Gly Met Lys Gly Lys Phe Asp His Val Phe Ser Phe Tyr Ala Leu
 100 105 110

His Trp Val Leu Asp Gln Glu Arg Val Phe Arg Asn Ile Tyr Asp Leu
 115 120 125

Leu Ser Lys Asp Gly Glu Cys Phe Thr Ile Phe Val Ala Gly Ala Pro
 130 135 140

Val Phe Asp Leu Tyr Arg Ile Leu Ser Arg Asn Asn Lys Trp Ser Thr
 145 150 155 160

Leu Leu Lys Asp Val Glu Lys Tyr Ile Ser Pro Tyr His Asp Ser Gln
 165 170 175

Asp Pro Ala Lys Glu Met Arg Lys Val Leu Glu Lys Val Gly Tyr Val
 180 185 190

Asp Tyr Lys Val Glu Cys Lys Asn Leu Val Tyr Met Tyr Asn Asn Phe
 195 200 205

Ala Ser Leu Trp Lys Thr Leu Gln Ala Ile Asn Pro Phe Asn Ile Pro
 210 215 220

Lys Asp Met Glu Glu Asp Phe Lys Gln Asp Tyr Leu Asn Ile Leu Lys
 225 230 235 240

Asp Met Lys Ile Val Ser Lys Tyr Asn Thr Asp Glu Ala Ser Val Asn
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Phe Lys Tyr Arg Leu Leu Val Val His Ala Arg Lys Pro Ala Ser Glu
 260 265 270

Phe

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 aagaatcata aactaaacaa atcaatatca cgaaattcaa atacctataa aaaaatcctt 120
 aaa atg aat aac gcg gtc ttg tat gaa aaa agc aat agc ttg cag aag 168
 Met Asn Asn Ala Val Leu Tyr Glu Lys Ser Asn Ser Leu Gln Lys
 1 5 10 15

| | |
|---|-----|
| aga gat gct atc atg tgt cta gaa gaa tac gct tcg aaa att aag tgg | 216 |
| Arg Asp Ala Ile Met Cys Leu Glu Glu Tyr Ala Ser Lys Ile Lys Trp | |
| 20 25 30 | |
| aag aag agt aat aat att ctt gac ata ggc tgt ggg gat gga agc | 264 |
| Lys Lys Ser Asn Asn Asn Ile Leu Asp Ile Gly Cys Gly Asp Gly Ser | |
| 35 40 45 | |
| gtg act aat atg ctg aag aaa tac atc cct act gag tac aag ttg ctt | 312 |
| Val Thr Asn Met Leu Lys Lys Tyr Ile Pro Thr Glu Tyr Lys Leu Leu | |
| 50 55 60 | |
| ggc tgt gat att agc gag aag atg gtg aac ttc gcg aat gat cat cat | 360 |
| Gly Cys Asp Ile Ser Glu Lys Met Val Asn Phe Ala Asn Asp His His | |
| 65 70 75 | |
| tgt aac gaa cag act tct ttc acc gtg ctc gat att gag gga gac cta | 408 |
| Cys Asn Glu Gln Thr Ser Phe Thr Val Leu Asp Ile Glu Gly Asp Leu | |
| 80 85 90 95 | |
| cct gaa ggt atg aag gga aac ttc gac cac gtt ttc tcg ttc tac gct | 456 |
| Pro Glu Gly Met Lys Gly Asn Phe His Val Phe Ser Phe Tyr Ala | |
| 100 105 110 | |
| ctg cac tgg gtt aat aac caa gaa cga gca ttc aaa aac ata tac aac | 504 |
| Leu His Trp Val Asn Asn Gln Glu Arg Ala Phe Lys Asn Ile Tyr Asn | |
| 115 120 125 | |
| ctt cta agc gag gat ggg gag tgc ttc acg ata ttc gta gcc tgg gct | 552 |
| Leu Leu Ser Glu Asp Gly Glu Cys Phe Thr Ile Phe Val Ala Trp Ala | |
| 130 135 140 | |
| cct gtg ttt gac gtg tac cga gtg ctc gcg cgc aac aac aag tgg agt | 600 |
| Pro Val Phe Asp Val Tyr Arg Val Leu Ala Arg Asn Asn Lys Trp Ser | |
| 145 150 155 | |
| caa tgg gtg cat gat gtc gac aga tac ata tcg ccc tac cac gac tct | 648 |
| Gln Trp Val His Asp Val Asp Arg Tyr Ile Ser Pro Tyr His Asp Ser | |
| 160 165 170 175 | |
| ttg gag ccg gaa aaa gat tta aag gct atg ata gac aaa att gga ttc | 696 |
| Leu Glu Pro Glu Lys Asp Leu Lys Ala Met Ile Asp Lys Ile Gly Phe | |
| 180 185 190 | |
| gtt gac atc gat gtg gaa tgt aaa gaa ttg gta ttc gtg tac gac aac | 744 |
| Val Asp Ile Asp Val Glu Cys Lys Glu Leu Val Phe Val Tyr Asp Asn | |
| 195 200 205 | |
| ata cat att ttg cga aaa gcg tta aca gca atc aac cct ttc aaa atc | 792 |
| Ile His Ile Leu Arg Lys Ala Leu Thr Ala Ile Asn Pro Phe Lys Ile | |
| 210 215 220 | |
| ccc aag gaa aaa tat gat gat ttc atg gaa gac tat atg gat ata ctg | 840 |

| | | | |
|---|-----|-----|------|
| Pro Lys Glu Lys Tyr Asp Asp Phe Met Glu Asp Tyr Met Asp Ile Leu | | | |
| 225 | 230 | 235 | |
| aaa gaa cta caa att tta gac aag tac aac aat aat tat gaa aag agc | | | 888 |
| Lys Glu Leu Gln Ile Leu Asp Lys Tyr Asn Asn Asn Tyr Glu Lys Ser | | | |
| 240 | 245 | 250 | 255 |
| gtt gaa ttc aat tac cgt ttg ctt gta gtg tat gcc cga aaa cct gac | | | 936 |
| Val Glu Phe Asn Tyr Arg Leu Leu Val Val Tyr Ala Arg Lys Pro Asp | | | |
| 260 | 265 | 270 | |
| tcg cag gat aaa atg tta gaa gct cta aat gga caa acg tag | | | 978 |
| Ser Gln Asp Lys Met Leu Glu Ala Leu Asn Gly Gln Thr | | | |
| 275 | 280 | | |
| actgaaaaac ttatattttt agttacggca aaatacagtg tagaacagtt attttagtt | | | 1038 |
| aaggatgaat gtatagtgta tctcttcagg ttttagtttg ggcctggtat gaaatgttgt | | | 1098 |
| tttttaagt aagctatttt ggtaatgtaa actatttta aaggcagggaa aataatctgt | | | 1158 |
| gtgtgagcaa aaaaaaaaaa aaaaaaaaaa aaaaa | | | 1193 |
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| 1 | 5 | 10 | 15 |
| Asp Ala Ile Met Cys Leu Glu Glu Tyr Ala Ser Lys Ile Lys Trp Lys | | | |
| 20 | 25 | 30 | |
| Lys Ser Asn Asn Ile Leu Asp Ile Gly Cys Gly Asp Gly Ser Val | | | |
| 35 | 40 | 45 | |
| Thr Asn Met Leu Lys Lys Tyr Ile Pro Thr Glu Tyr Lys Leu Leu Gly | | | |
| 50 | 55 | 60 | |
| Cys Asp Ile Ser Glu Lys Met Val Asn Phe Ala Asn Asp His His Cys | | | |
| 65 | 70 | 75 | 80 |
| Asn Glu Gln Thr Ser Phe Thr Val Leu Asp Ile Glu Gly Asp Leu Pro | | | |
| 85 | 90 | 95 | |
| Glu Gly Met Lys Gly Asn Phe Asp His Val Phe Ser Phe Tyr Ala Leu | | | |
| 100 | 105 | 110 | |
| His Trp Val Asn Asn Gln Glu Arg Ala Phe Lys Asn Ile Tyr Asn Leu | | | |
| 115 | 120 | 125 | |

Leu Ser Glu Asp Gly Glu Cys Phe Thr Ile Phe Val Ala Trp Ala Pro
 130 135 140
 Val Phe Asp Val Tyr Arg Val Leu Ala Arg Asn Asn Lys Trp Ser Gln
 145 150 155 160
 Trp Val His Asp Val Asp Arg Tyr Ile Ser Pro Tyr His Asp Ser Leu
 165 170 175
 Glu Pro Glu Lys Asp Leu Lys Ala Met Ile Asp Lys Ile Gly Phe Val
 180 185 190
 Asp Ile Asp Val Glu Cys Lys Glu Leu Val Phe Val Tyr Asp Asn Ile
 195 200 205
 His Ile Leu Arg Lys Ala Leu Thr Ala Ile Asn Pro Phe Lys Ile Pro
 210 215 220
 Lys Glu Lys Tyr Asp Asp Phe Met Glu Asp Tyr Met Asp Ile Leu Lys
 225 230 235 240
 Glu Leu Gln Ile Leu Asp Lys Tyr Asn Asn Asn Tyr Glu Lys Ser Val
 245 250 255
 Glu Phe Asn Tyr Arg Leu Leu Val Val Tyr Ala Arg Lys Pro Asp Ser
 260 265 270
 Gln Asp Lys Met Leu Glu Ala Leu Asn Gly Gln Thr
 275 280

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 <220>
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17

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 <400> 12
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10

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| <211> 30 | |
| <212> DNA | |
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| <220> | |
| <223> an artificially synthesized primer sequence | |
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| <400> 16 | |
| aaggatccaa tcacgaaaaat ctggaaagac | 30 |
| | |
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| <211> 30 | |
| <212> DNA | |
| <213> Artificial | |

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| <400> 17 | | |
| aaacatatga atcaggcctc tctatatcag | | 30 |
| <210> 18 | | |
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| <212> DNA | | |
| <213> Artificial | | |
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| <400> 18 | | |
| aaggatccga ctctgttaac aaatgcaatt actg | | 34 |
| <210> 19 | | |
| <211> 23 | | |
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| <213> Artificial | | |
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| <220> | | |
| <221> misc_feature | | |
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| <223> "n"=A, T, G or C | | |
| <400> 19 | | |
| atggtnaart aygcnayaa rca | | 23 |
| <210> 20 | | |
| <211> 23 | | |
| <212> DNA | | |
| <213> Artificial | | |
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| <223> "n"=A, T, G or C | | |

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| <221> misc_feature | | |
| <222> (12)..(12) | | |
| <223> "n"=A,T,G or C | | |
| <400> 20 | | |
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| <210> 21 | | |
| <211> 28 | | |
| <212> DNA | | |
| <213> Artificial | | |
| <220> | | |
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| <400> 21 | | |
| ttcacagtgc tggacatcgc aggagata | | 28 |
| <210> 22 | | |
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| <213> Artificial | | |
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| <400> 23 | | |
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| <210> 24 | | |
| <211> 26 | | |
| <212> DNA | | |
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| <220> | | |
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| <400> 24 | | |

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| aaacatatga ataacgccgt tttgtacgaa | 30 |
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| <212> DNA | |
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| <400> 26 | |
| aactcgagct tgcatacggt tttgttattg | 30 |
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| aaacatatga ataacgccgt cttgtatgaa | 30 |
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| <400> 28 | |
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<223> "Xaa"=Asp or Glu

<220>

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<222> (3)..(3)

<223> "Xaa"=hydrophobic amino acid

<220>

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<222> (5)..(5)

<223> "Xaa"=low molecular weight neutral amino acid

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<222> (7)..(7)

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Leu Xaa Xaa Gly Xaa Gly Xaa Gly

1 5

<210> 30

<211> 18

<212> PRT

<213> Artificial

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<223> "Xaa"=any amino acid

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<222> (8)..(8)

<223> "Xaa"=Gln or Glu

<220>

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<222> (9)..(9)

<223> "Xaa"=His, Lys or Gln

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<222> (13)..(13)
<223> "Xaa"=hydrophobic amino acid

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Asp Ala

<210> 31
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<220>
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<400> 31
Xaa Leu Asp Xaa Gly Cys Gly Asp Gly
1           5

<210> 32
<211> 12
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<220>
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<223> "Xaa"=Leu or Val

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<223> "Xaa"=Gln or Lys

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1           5           10

<210> 33
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<223> "Xaa"=Cys, Thr or Ala

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Phe Asp His Val Phe Ser Phe Tyr Xaa Leu His Trp Val
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<210> 34
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<223> "Xaa"=Val or Ile

<220>
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<222> (5)..(5)
<223> "Xaa"=Val, Ile or Leu

<220>
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<223> "Xaa"=Ile or Val

<400> 34
Pro Xaa Phe Asp Xaa Tyr Arg Xaa Leu
1           5
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<210> 35
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<220>
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<220>
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<210> 36
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<220>
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<400> 36
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1 5 10

<210> 37
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<220>
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<400> 37
Met Val Lys Tyr Ala Asn Lys His
1 5

<210> 38
<211> 8
<212> PRT
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<220>

<223> Amino acid sequence encoded from DGJR primer

<400> 38

Phe Asp His Val Phe Ser Phe Tyr

1 5